Criteria and Rating Guidelines for Hazard Elimination Program

Projects considered for funding under the hazard elimination program are sub-divided into two groups. Group I projects address the safety concerns of locations with a high accident history. Examples of Group I projects are installation of new traffic signals, channelization, and curve realignment. The Group II projects address the safety concerns of locations that have a high accident potential. Examples of Group II projects are guard rail installation, bridge end protection, and removal or protection of roadside obstacles.

The intent of hazard elimination program is to eliminate or reduce hazards at a specific locations, not long segments of roadway. In addition, upgrading an existing condition to current standards will not be funded under this program unless it can be shown as incidental to other work being done. All project selections will be based upon information provided in the application and on a field review of the project.

Calculations of Rating for Group I (High Accident Location)

The Calculation of Group I project ratings is based on a Benefit/Cost Ratio. Accident reduction factors are used in calculating a project's annual benefit. The reduction factors represent a theoretical reductions in implementing various types of improvement(s). The reduction factors were prepared using historical data from several states. The data is considered sound enough to provide a general comparison of estimated cost calculations.

Accident Group Data

Fatality & Injury Cost Factor (Q_{FI}) = \$32,800 / Number of Injury or Fatal Accidents
Property Damage Cost Factor (Q_{PD}) = \$5,800 / Accident

Traffic Growth Rate

Traffic Average Growth $Rate_{Intersection}(G)$ = (Growth $Rate_{Mainline}$ + Growth $Rate_{Crossroad}$)/2
Traffic Average Growth $Rate_{Roadway}(G)$ = Growth $Rate_{Mainline}$

Growth $Rate_{ML}$ = ((Design Year ADT_{ML} - Existing ADT_{ML})/(Design Year - Current Year)) / Existing ADT_{ML}

Growth $Rate_{CR}$ = ((Design Year ADT_{CR} - Existing ADT_{CR})/(Design Year - Current Year)/ Existing ADT_{CR}

Example: Current Year = 1994 Design Year = 2014

Current Mainline ADT = 15,650 Design Year ADT = 25,000
Current Crossroad ADT = 3,200 Design Year ADT = 4,000

Growth Rate$_{ML}$ = ((25,000 - 15,650) / (2014 - 1994)) / 15650 = 0.0299

Growth Rate$_{CR}$ = ((4,000 - 3,200) / (2014 - 1994)) / 3,200 = 0.0125

Traffic Average Growth Rate = (0.0299 + 0.0125) / 2 = 0.0212

Accident Reduction Formula

If more than one improvement is being considered at a location, the projected accident reduction factor is not simply the sum of the accident reduction factors for each improvement. When multiple improvements are proposed, the projected accident reduction factor can be determined by using the following equation.

$$Red_{total} = Red_1 + [(100-Red_1)/100] \times Red_2 + [(100-Red_1)/100] \times [(100 - Red_2)/100] \times Red_3 + ...$$

Red_{Total} = Total reduction factor in percent for the proposed project.

Red_1 = The largest reduction factor in a type of improvement.

Red_2 = The second largest reduction factor in a type of improvement

Red_3 = The third largest reduction factor in a type of improvement.

Two Reduction factors will need to be calculated for each project. A fatality & injury reduction (Red_{FI}) and property damage reduction (Red_{PD}). A list of reduction factors may be found on the next page; these vary by type of area - urban or rural - and the number of lanes on the facility.

Example: Project Description: The project will consist of installing a new actuated traffic signal and interconnecting this signal with other signals nearby. This project is located in a urban area with two lanes in each direction.

Factors:(See Page 3 & 4)

Add Traffic Signals Red_{FI} = 50 Red_{PD} = 30
Interconnect Signals Red_{FI} = 30 Red_{PD} = 30

$Red_{Total\ FI}$ = 50 + {(100 - 50)/100}* 30 = 65
$Red_{Total\ PD}$ = 30 + {(100-30)/100} * 30 = 51

Accident Reduction Factors

Type	Urban Rural	Improvement	Number of Lanes	Fatality & Injury Reduction	Property Damage Reduction
Intersection	R	Add Stop Signs on Minor Leg	2	80	65
	U	Add Stop Signs on Minor Leg	2	70	50
	U	Add Stop Signs on Minor Leg	Multi	20	40
	U	Add Stop Signs on All Legs	2	65	70
	Both	Add Right Turn Lane	Multi	40	10
	Both	Add Left Turn Lane	2	80	20
	U	Add Left Turn Lane	Multi	55	5
	U	Add Left Turn Lane at T-Intersection	2	80	80
	U	Add Left Turn Lane at T-Intersection	Multi	60	50
	R	Add Left Turn Lane at Y-Intersection	2	5	35
	Both	*Increase Radii at Intersection	All	25	25
	Both	Add Traffic Signals	All	50	30
	U	Add Left Turn Signal (No Left Turn Lane)	Multi	55	40
	Both	Modify Traffic Signals	All	30	30
	Both	Interconnect Traffic Signals	All	30	30
	U	Add Pedestrian Signals	2	55	15
	U	Add Pedestrian Signals	Multi	40	5
	R	Install Flashing Warning Signals	2	30	50
	R	Install Flashing Warning Signals	Multi	15	20
	U	Install Flashing Warning Signals	Multi	30	50
	Both	Add Flashing Beacons at RR Crossing	Multi	50	80
	U	Illuminate Intersection or RR Crossing	All	15	20
Delineation	U	Double Yellow Line	Multi	5	5
	Both	Reflectorized Raised Pavement Marking	Multi	5	5
	R	Edge Marking	2	15	15
	Both	Guide Posts on Curve	All	25	25
Roadway	R	*Widen Traveled Way	2	30	40
	R	*Widen Shoulders	2	5	20
	U	Eliminated Parking (Signing Necessary)	Multi	5	30

* Use the Full Reduction Percent only when only the project results in a significant improvement over the existing condition.

Accident Reduction Factors

Type	Urban Rural	Improvement	Number of Lanes	Fatality & Injury Reduction	Property Damage Reduction
	Both	Construct Grade Separation	All	60	60
	Both	Add Two Way Left Turn Lane	All	50	50
	Both	Widen Bridge (Minimum 6')	All	60	60
	Both	*Reconstruct Curve	All	80	80
	Both	Grooving Pavement	All	15	25
Roadside	Both	Guardrails at Embankments	All	20	20
	Both	Guardrails at Bridge Ends, Abutments, Piers, Steel Posts	All	50	35
	Both	Flatten Side Slopes	2	20	20
	Both	Energy Absorption Devices	All	50	20
	Both	Breakaway Sign Posts and Illumination Poles	All	50	0
Median	U	Painted or Raised Median	All	10	10
	U	Concrete Median Barrier	All	60	60
Signing	R	Install Advanced Warning Signs	2	30	35
	R	Install Advanced Warning Signs	Multi	5	20
	U	Install Advanced Warning Signs	2	15	15
	U	Install Advanced Warning Signs	Multi	20	20
	U	Install Yield Sign	2	80	60

* Use the Full Reduction Percent only when only the project results in a significant improvement over the existing condition.

Annual Benefit

Years History = Years of accident history for the collected accident data (3 years)
Fatal = The number of attributable fatal accidents during the collection period.
Injuries = The number of attributable injury accidents during the collection period.
Property Damage = The number of attributable property damage accidents

Annual Benefit = $(1 + G)\{(((Q_{FI}) * (\text{Fatalities} + \text{Injuries}))/(\text{Years History}))*(Red_{FI}/100) + (((Q_{PD}) * (\text{Property Damage}))/(\text{Years History}))*(Red_{PD}/100)\}$

Example:

Number of property damage accidents attributable to absence of the improvement.
1991 = 3 1992 = 3 1993 =2 Total = 8

Number of injuries accidents attributable to absence of the proposed improvement.
1991 = 1 1992 = 0 1993 = 1 Total = 2

Number of fatalities accidents attributable to absence of the proposed improvement.
1991 = 0 1992 = 1 1993 = 0 Total = 1

Annual Benefit = (1+0.0212){(($32,800)*(1+2))/(3))*(65/100) +
(($5,800)*(8))/(3))*(51/100)= $29,827

Annual Cost

Annual Cost = Total Project Cost * Cost Recovery Factor

Cost Recover Factor = 0.1175

Example: Total Project Cost = $194,400

Annual Cost = $194,000 * 0.1175 = $22,795

Benefit Cost Ratio

Benefit Cost Ratio = Annual Benefit / Annual Cost

Example Benefit/Cost Ratio = $29,827/$22,795 = 1.31

Rating Calculations for Group II Locations (High Accident Potential)

The Calculation of Group II project ratings is based on the existing conditions at the project site.

ADT Rating (Factor$_{ADT}$):
Average daily traffic volume for the section or segment identified.

Traffic Volume	Points
0-49	0
50-99	1
100-399	2
400-899	3
900-1599	4
1600-2499	5
2500-3999	6
4000-5999	7
6000-7999	8
8000-9999	9
10000+	10

Offset from Centerline Rating (Factor$_{Offset\ Right}$ & Factor$_{Offset\ Left}$):
Distance in feet measured from the centerline of the roadway to the nearest edge of the identified hazard. For those hazards which occur of both sides of the road, this factor is applied separately to each side.

Offset (Feet)	Points
<12	5
12-13.9	4
14-15.9	3
16-17.9	2
18-19.9	1
>20	0

Embankment Height Rating (Factor$_{Embankment}$):
The height of the embankment or the difference between the roadway elevation and the ground or water it crosses.

Embankment Height (Feet)	Points
<15	0
15-29.9	3
>30	5

Curve Rating (Factor$_{Curve}$):
If the hazard is located on the outside of a curve.

Outside of Curve	Points
Y	2
N	0

Curve Safe Speed Rating (Factor$_{Speed}$):
If the posted safe curve speed is more than 10 mph below the posted speed limit.

Posted Safe Speed	Points
<10 mph	0
>10 mph	3

Bridge Ends Ratings (Factor$_{Bridge}$):
If the unprotected bridge ends are being protected by the proposed project.

Bridge Ends	Points
Y	5
N	0

Water Ratings (Factor$_{Water}$):
If there is water over 2 feet(year round) being protected by the proposed project.

Water	Points
<2 feet	0
>2 feet	5

Structures (Factor$_{Structure}$):
If there is a structure being protected by the proposed project (home, barn, etc.)

Structure	Points
Y	2
N	0

Tree & Poles (Factor$_{Tree\ \&\ Poles}$):
If there are tree, poles and fences being protected by the proposed projects.

Trees & Poles	Points
Y	2
N	0

Other Rating (Factor$_{Other}$**):**
If there are other types of hazards being protected by the proposed project (rocks, boulders, or other usually conditions with were not addressed with other factors).

Other	Points
Y	2
N	0

Accident Rating ($Factor_{Accidents}$):

Number of Accidents = The actual number of accidents at the project location.

Year of Accident History = The number the years that accident history is recorded (3 years).

Accident Rate = Number of Accidents / Years of Accident History

Accident Rating	Points
<0.1	0
0.1 - 0.9	3
>0.9	5

Speed Adjustment:

The rating is adjusted if the posted speed limit is less than 35 mph.

Speed	Adjustment
<35mph	1
>35mph	0.9

Total Rating:

The sum of all rating factors associated with the existing area that the proposed project will address.

Total Rating = ($Factor_{ADT}$ + $Factor_{Offset\ Right}$ + $Factor_{Offset\ Left}$ + $Factor_{Embankment}$ + $Factor_{Curve}$ + $Factor_{Speed}$ + $Factor_{Bridge}$ + $Factor_{Water}$ + $Factor_{Structure}$ + $Factor_{Tree\ \&\ Poles}$ + $Factor_{Other}$ + $Factor_{Accidents}$) * Speed Adjustment

Example Project Description: The road is a heavily traveled route on both sides of the segment. This is a narrow crossing, which provides no protection for the existing bridge.

ADT = 2301	Posted Speed = 45 mph.	Distance to hazard = 12 feet
Embankment = 10ft	Outside Curve = Y	Curve Speed = 35 mph
Water over 2ft = Y	Bridge Ends = Y	Structures = N
Utility Pole & Trees = Y	Other = N	Accident in 3 years = 3

$Factor_{ADT}$ = 5	$Factor_{Offset\ Right}$ = 4	$Factor_{Offset\ Left}$ = 4
$Factor_{Embankment}$ = 0	$Factor_{Curve}$ = 2	$Factor_{Speed}$ = 3
$Factor_{Bridge}$ = 5	$Factor_{Water}$ = 5	$Factor_{Structure}$ = 0
$Factor_{Tree\ \&\ Poles}$ = 2	$Factor_{Other}$ = 0	$Factor_{Accidents}$ = 5
Speed adjustment = 1		

Total Rating = (5+4+4+0+2+3+5+5+0+2+0+5)*1 = 35